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Egyptian Pediatric Association Gazette (2025) 73:76
https://doi.org/10.1186/s43054-025-00420-4

Egyptian Pediatric Association Gazette

RESEARCH Open Access

Clinical characteristics and endoscopic outcomes of upper GI foreign bodies in children: sedated versus unsedated approaches

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Abstract

Objective To investigate the clinical characteristics of upper gastrointestinal foreign bodies in children and compare the clinical efficacy and safety of painless gastroscopy versus conventional gastroscopy for foreign body extraction.

Methods A retrospective analysis was conducted on 278 pediatric cases (from January 2014 to June 2024) with upper gastrointestinal foreign bodies, focusing on age distribution, common types and locations of foreign bodies. Patients were divided into a painless gastroscopy group ($n=223$) and a conventional gastroscopy group ($n=53$) based on whether anesthesia was administered. In the painless gastroscopy group, intravenous access was established followed by administration of combined anesthesia (sufentanil and propofol), with the procedure initiated upon confirmation of eyelash reflex loss and muscle relaxation, while the conventional group underwent standard endoscopic foreign body extraction without sedation. The two groups were subsequently compared regarding foreign body characteristics, procedural success rates, and postoperative complication incidence.

Results The age of affected children ranged from 1 month to 14 years, with a mean age of 3.285 ± 2.47 years, predominantly under 6 years old. The most common foreign body was coins, and the most frequent locations were the stomach and duodenum. The success rate of foreign body extraction was higher in the painless gastroscopy group than in the conventional group ($\chi^2=4.537$, $P=0.033$). Additionally, the incidence of complications in the painless group was significantly lower than in the conventional group, with a statistically significant difference ($\chi^2=10.443$, $P<0.001$).

Conclusion Upper gastrointestinal foreign bodies in children occur most frequently in infants and young children, with coins and fragments of snacks or toys being the most common objects, primarily lodged in the stomach and duodenum. Painless gastroscopy for foreign body extraction improves treatment compliance, reduces adverse reactions, and demonstrates superior safety and efficacy compared to conventional gastroscopy, making it worthy of clinical application.

Keywords Upper gastrointestinal foreign bodies, Gastroscopy, Children, Efficacy, Paediatric surgical training

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Introduction

Upper gastrointestinal foreign bodies (UGIFBs) refer to indigestible objects that become lodged in the upper gastrointestinal tract and cannot be promptly expelled. This condition represents one of the most frequent emergencies encountered in clinical gastroenterology [1, 2]. Approximately 80% of pediatric UGIFB cases occur in children under three years of age, primarily due to accidental ingestion. The presence of UGIFBs poses significant health risks, potentially affecting both the clinical course and prognosis of affected children. If not managed promptly or appropriately, serious complications may arise, including esophageal perforation, stenosis, mediastinitis, tracheoesophageal fistula, and even mortality [3, 4].

In clinical practice, endoscopic removal using either conventional or painless electronic gastroscopy remains the primary approach for UGIFB management. Gastroscopic intervention is widely adopted in pediatric cases due to its efficiency, safety, and effectiveness. However, conventional gastroscopy often induces substantial discomfort in children, leading to pain, fear, crying, and poor compliance and tolerance. These factors may increase the risk of complications, such as esophageal perforation, during the removal procedure [4–8]. In contrast, painless electronic gastroscopy, performed under sedation-induced unconsciousness prior to endoscopic exploration, minimizes pediatric distress, enhances treatment compliance, and ultimately improves procedural success rates.

The clinical application of painless gastroscopy has gained increasing recognition in recent years due to its demonstrated benefits in improving therapeutic outcomes and diagnostic quality in pediatric patients. Nevertheless, unlike many international counterparts, China currently lacks standardized protocols for the management of pediatric UGIFBs [9]. This study conducted a retrospective analysis of clinical characteristics in 278 cases of pediatric UGIFBs resulting from accidental ingestion. Furthermore, it evaluated and compared the clinical efficacy and safety profiles of painless gastroscopy versus conventional gastroscopy in UGIFB management. The findings aim to provide valuable insights and references for optimizing therapeutic approaches to digestive tract foreign bodies in pediatric populations.

Data and methods

General information

In this study, 278 children with upper gastrointestinal foreign body eaten by mistake from January 2014 to June 2024 from Anhui Children's Hospital were selected as the study subjects.

Inclusion criteria: (1) Under the age of 18 years old; (2) The patient was diagnosed as upper gastrointestinal foreign body according to the Expert Consensus on Endoscopic Treatment of Upper Gastrointestinal Foreign Body in China issued by the Digestive Endoscopy Branch of the Chinese Medical Association in 2015; (3) The patient had complete clinical data and the whole treatment process was only completed in our hospital; (4) The informed consent form was signed.

Exclusion criteria: (1) No complete clinical data; (2) Other digestive tract diseases or contraindications; (3) Other types of diseases.

Research methods

The clinical data of all children were collected, including gender, age, and the related features of upper gastrointestinal foreign body. All pediatric patients received endoscopic procedures at our center and were assigned to either painless (with anesthesia) or conventional (without anesthesia) gastroscopy groups. In the painless gastroscopy group, venous channels were first established, 5% glucose was infused, with ECG monitoring and oxygen inhaled through nasal catheter (at a flow rate of 2L/min), fentanyl of 0.5-1.0mg/kg and propofol of 2.0-3.0mg/kg were slowly injected intravenously successively, and gastroscopy was performed after the eyelash reaction of the children disappeared and the muscles of the whole body relaxed. The children in the conventional gastroscopy group were instructed to take 1mL/kg of 2% lidocaine mucilage 5 to 10 minutes before the operation, and then Fujinon EG-270NS electronic gastroscope was used to conduct endoscopy along the cavity according to the routine examination of gastroscope. After found, the foreign body was taken out with instruments (such as alligator forceps, foreign body forceps, snare device, basket, three-claw forceps, and snare wire) selected according to the shape, edge nature and incarceration position of the foreign body, and after clamped, the foreign body was withdrawn while the long axis of the foreign body was parallel to the longitudinal axis of the esophagus. The foreign body removal effect (success rate, complications, etc.) of the two groups were observed.

Statistical analysis

The data of this study were processed by SPSS 25.0 statistical software. The measurement data conforming to the normal distribution was expressed as mean ± standard deviation ($x \pm s$), the inter group comparison was performed by t test or F test, the counting data was expressed as rate (%), and the inter group single factor comparison was performed by χ^2 test. All analyses were performed by bilateral test, and $P<0.05$ indicated that the difference was statistically significant.

Results

Clinical features of children with upper gastrointestinal foreign body

The children involved in this study were between 1 month and 14 years old, with an average age of (3.285 ± 2.47) years, and were mainly composed of children under 6 years old. The course of disease ranged from 2 hours to 1 year, with a long-time span, and the common ones were mild patients diagnosed within a week. Patients were subsequently categorized into two groups based on the type of gastroscopy performed: the conventional gastroscopy group and the painless gastroscopy group (Table 1). General information such as the age, gender and course of disease of the two groups of children was not significantly different ($P>0.05$), which was comparable (Table 1). The types and locations of foreign bodies exhibit significant variation, with coins being the most commonly encountered type, accounting for over 28% of all cases (Table 1). Based on their anatomical distribution (Fig. 1), UGIFBs may lodge in the esophagus (Fig. 2), stomach (Fig. 3), or duodenum (Fig. 4). However, in our study, the duodenum was the predominant site of impaction, representing more than 50% of cases, while the esophagus and stomach accounted for approximately 10% and 30%, respectively (Table 1).

Success rate of removal and postoperative complications of two groups of children

Table 2 shows that the success removal rate (93.72%) of foreign bodies in the painless gastroscopy group is higher than that in the conventional gastroscopy group (84.91%). 223 cases underwent painless gastroscopy removal, of which 209 foreign bodies were successfully removed, foreign bodies of 53 cases were removed by conventional gastroscope, and 45 cases of which were successful. The success rate of the two methods was significantly different (χ^2 =4.537, P=0.033). In these cases, the foreign bodies could not be retrieved endoscopically due to their small size and distal location within the gastrointestinal tract. The objects passed spontaneously through the bowel and were excreted naturally without requiring further intervention. Given the low risk of complications (e.g., obstruction or perforation) attributable to the

Table 1 General situation of patients with upper gastrointestinal foreign body

Index		Conventional gastroscopy [n(%)]	Painless gastroscopy [n(%)]	χ^2	*P value*
Gender				2.989	0.084
	Male	30 (57%)	154 (69%)		
	Female	23 (43%)	69 (31%)		
Age				5.066	0.079
	3 years old or younger (min 1 month)	36 (68%)	143 (64%)		
	3–6 years old	6 (11%)	52 (23%)		
	6 years old or older (max 14 years old)	11 (21%)	28 (13%)		
Type of foreign body				4.606	0.440
	Coin	20 (38%)	59 (26%)		
	Metal	3 (6%)	42 (19%)		
	Plastic	4 (8%)	54 (24%)		
	Battery	6 (11%)	21 (9%)		
	Food	12 (23%)	28 (13%)		
	Others	8 (15%)	19 (9%)		
Location of foreign body				0.057	0.972
	Esophagus	6 (11%)	23 (10%)		
	Stomach	17 (32%)	74 (33%)		
	Duodenum	30 (57%)	126 (57%)		
Retention time of foreign body				1.435	0.488
	4 h or shorter	13 (25%)	71 (30%)		
	4–8 h	8 (15%)	37 (16%)		
	8 h or longer	32 (60%)	115 (52%)		
Symptoms caused by foreign body				2.368	0. 124
	Nausea, emesis, pain, etc	14 (26%)	50 (22%)		
	None	39 (74%)	173 (78%)		

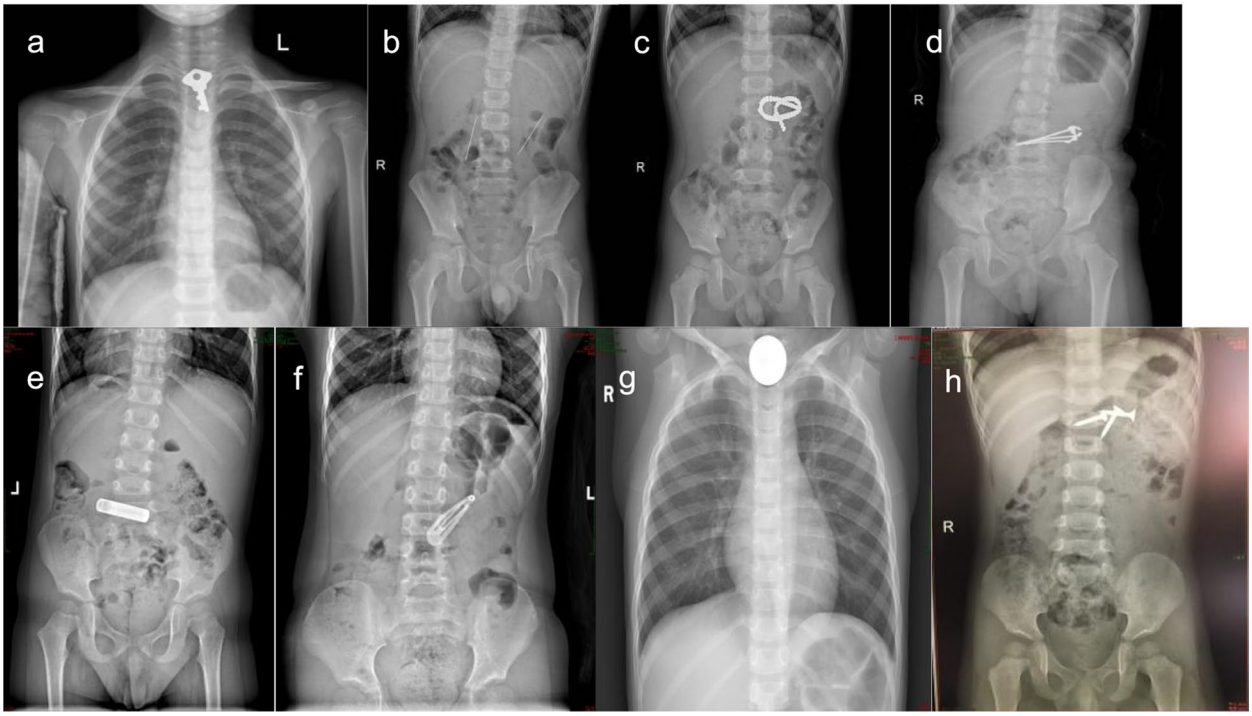

Figure1 X-ray of UGIFBs (Posteroanterior views): (**a**) Key; (**b**) Pin; (**c**) Magnetic bead; (**d**) Nail clipper; (**e**) AAA battery (Size 7 battery); (**f**) Hairpin; (**g**) Button battery; (**h**) Screw

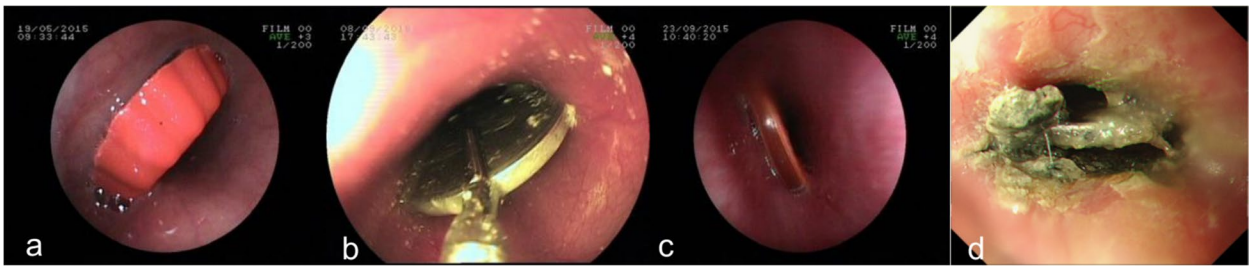

Fig. 2 Endoscopic views of UGIFBs in esophagus: (**a**) Bottle cap; (**b**) Coin; (**c**) Button; (**d**) Button battery

objects' small dimensions and smooth contours, neither surgical nor repeat endoscopic intervention was necessary. All patients were managed conservatively with outpatient monitoring, and none developed adverse sequelae. Among 278 cases of endoscopic foreign body removal, 38 cases had complications, with the incidence rate of 13.77%. The complications in the painless gastroscopy group were significantly lower than those in the conventional gastroscopy group, and the difference was statistically significant (P<0.001), as shown in Table 3.

Discussion

Upper gastrointestinal foreign body is a common critical disease in pediatric children. It is reported that about 1,500 patients die of upper gastrointestinal foreign body every year in the United States, of which upper gastrointestinal foreign body in children accounts for 80% [10, 11]. Statistical analysis of this study shows that children of 3 years and below has the highest incidence rate of upper gastrointestinal foreign body, accounting for 51.85%, and the ratio of male to female is 1.51: 1, which is basically consistent with the research results at home and abroad. Children from 1 to 3 years old have certain spatial activity ability, strong curiosity, active and lack of danger awareness, and especially children explore the nature of substances through the oral cavity and are thus prone to swallow foreign bodies to the upper digestive tract. Our research results show that coins, fragments of snack toys and hair clips are the most common upper gastrointestinal foreign bodies in children, which is consistent with most studies reported in China [4, 12, 13]. At the same time, in different regions, there are

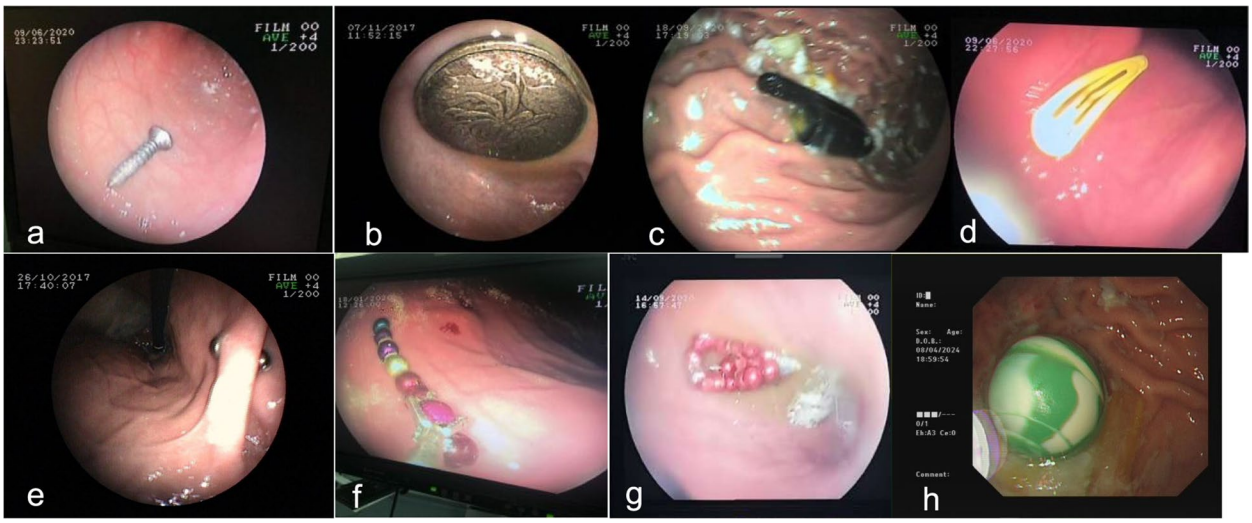

Fig. 3 Endoscopic views of UGIFBs in stomach: (**a**) Screw; (**b**) Coin; (**c**) Pen cap; (**d**) Hairpin; (**e**–**g**) Magnetic beads; (**h**) Plastic ball

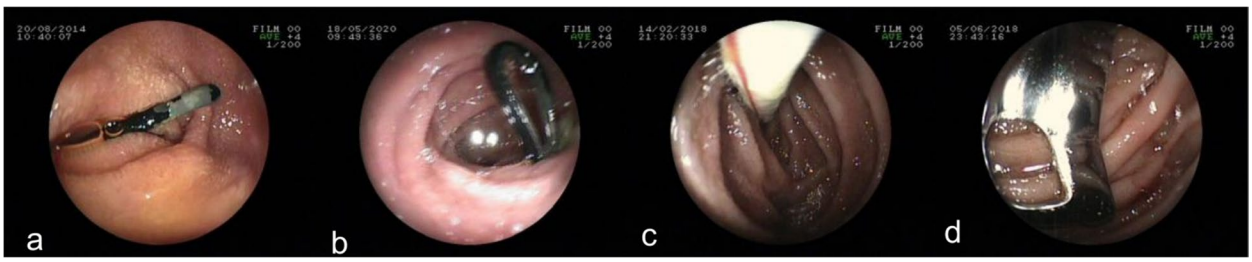

Fig. 4 Endoscopic views of UGIFBs in duodenum: (**a**-**b**) Hairpin; (**c**) Lollipop stick; (**d**) Zipper pull tab (metal)

Table 2 Comparison of success rates of foreign body removal under gastroscopy

Type of gastroscopy	Foreign body removal [n (%)]		χ^2	*P* value
	Succeeded	Failed		
Conventional gastroscopy ($n=53$)	45 (84.91)	8 (15.09)	4.537	0.033
Painless gastroscopy ($n=223$)	209 (93.72)	14 (6.28)		

dietary cultural differences in the types of upper gastrointestinal foreign body, that is, the most common ones are food lumps, broken seed shells, nuts, peanuts, etc [12]., and foreign bodies reported in China are mainly peanuts, walnuts, melon seeds and poultry bones [10, 11].

In recent years, electronic gastroscope has gradually been widely used in clinical practice, but the gastroscope tube is inserted through the mouth as an invasive test during conventional gastroscopy, causing nausea, hiccups, coughing, restlessness and other adverse reactions of patients in examination [14, 15]. However, due to poor compliance and treatment tolerance of children, the operation was more difficult, and complications such as digestive tract mucous membrane damage, perforation, and bleeding can be easily caused by local damage of the foreign body in children [6, 15]. The emotional stability and cooperation of children during the removal of upper gastrointestinal foreign body under electronic gastroscope are the key to improve the therapeutic effect.

Table 3 Complications after foreign body removal

Type of gastroscopy	Foreign body removal [n(%)]				χ^2	*P value*
	Erosion	Ulcer	Bleeding	Perforation		
Conventional gastroscopy ($n=53$)	10 (18.87)	5 (9.43)	0	0	10.443	< 0.001
Painless gastroscopy ($n=223$)	5 (2.24)	18 (8.07)	0	0		

Therefore, the first choice for diagnosis and treatment of upper gastrointestinal foreign body in children is painless gastroscopy [8, 9, 16]. The painless gastroscopy is easy to operate, effective and safe, and easily accepted by children and their families. In this study, foreign bodies in 7 children in the conventional gastroscopy group were still unable to be removed after many attempts and then the children were switched to surgery under intravenous anesthesia. It is obvious that painless gastroscopy has a higher rate of foreign body removal, with postoperative complications lower than those of the conventional gastroscopy group. Especially for some difficult foreign body removal, endoscopic operation under anesthesia can eliminate fear and tension of children, thus improving the success rate of surgery [17, 18].

In terms of complications after removal, although no serious complications such as laryngeal edema, massive hemorrhage and asphyxia occurred in the two groups, this study found that the two groups had different proportions of common postoperative complications such as erosion and ulcer, and the incidence rate of complications in the painless gastroscopy group was significantly lower than that in the conventional gastroscopy group. In this study, children with upper gastrointestinal foreign body had a certain proportion of symptoms, we believe that it may be caused by long retention time of foreign bodies, and it can be observed that the retention time of foreign bodies is 8 hours or more, which accounts for the majority and may affect the incidence rate of postoperative complications [19], although there is no difference in the distribution between the two groups. In addition, there are many factors that affect the risk of this operation, such as foreign bodies of different properties and different retention sites. Hard objects will increase the risk of digestive tract injury, and sharp edge of hard objects will not only increase the risk of gastrointestinal bleeding, perforation and ulcer due to the longer retention time, but also increase the risk in foreign body removal [6, 20, 21].

Conclusions

In conclusion, the use of painless gastroscopy for upper gastrointestinal foreign body removal in children demonstrates significant clinical benefits, including reduced fear, improved cooperation, and higher success rates, while also minimizing complications such as gastrointestinal bleeding and mucosal injury. These findings underscore its safety and substantial clinical value. However, it is important to note that this study's sample population was primarily drawn from Anhui Province, China, and its neighboring regions, which may limit the generalizability of the results. Further research across diverse geographic and demographic settings is warranted to validate these findings and enhance their global applicability.

Authors' contributions

Z.W., M.Z. and Y.W. wrote the main manuscript and prepared the figures. L.L., and A.C. helped with operation and materials preparation. All authors gave critical feedback and approved the research.

Funding

This project is supported by the Fund (AHWJ2021b101) from Anhui Provincial Health Research Project, China.

Data availability

Data is available with the corresponding author whenever ordered.

Declarations

Ethics approval and consent to participate

The Research Ethics Committee of Anhui Provincial Children's Hospital granted approval for this study (Registration No. EYLL-2023–010). Informed verbal consent was obtained from the legal guardians of all participants who agreed to take part in the research. The committee provided written consent for the study. The research was conducted in accordance with the ethical standards established by the Declaration of Helsinki in 1975, including all subsequent amendments. All procedures were performed in strict compliance with these ethical guidelines.

Competing interests

The authors declare no competing interests.

Received: 12 March 2025 Accepted: 14 August 2025
Published online: 02 September 2025

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